

## **REMARKS**

Reconsideration is respectfully requested.

### **I. Status of the Claims**

Claims 1-7 and 9-12 are pending, with claim 8 having previously been canceled. No new matter is introduced.

### **II. Rejections under 35 U.S.C. §§ 102 103**

Claims 10 – 12 are rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Publication No. H987 to Buchanan et al. (“Buchanan”). Claim 10 is rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent Publication No. 2002/0090335 to Harada et al. (“Harada”). Claims 1, 5 – 7, 9 and 10 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Harada in view of U.S. Patent No. 6,827,916 to Guo et al. (“Guo”) and U.S. Patent No. 4,173,485 to Woditsch et al. (“Woditsch”). Claims 2 – 4 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Harada in view of Woditsch and U.S. Patent No. 2,985,506 to Vita et al. (“Vita”). Claim 2 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Harada in view of Guo, Woditsch and U.S. Patent Publication no. 2003/0022784 to Kawamoto et al. (“Kawamoto”). Claim 5 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Harada in view of Guo, Woditsch and either U.S. Patent No. 4,520,004 to Uedaira et al. (“Uedaira”) or U.S. Patent No. 6,129,903 to Kerchner (“Kerchner”). Applicants respectfully traverse the rejections of claims 1 – 7 and 9 – 12 under 35 U.S.C. §§ 102(b), 103(a).

In independent claim 1, Applicants claim:

1. A process for the preparation of barium titanate powders, comprising separately and simultaneously introducing into a high-gravity reactor an aqueous solution (I) containing salts or organometallic compounds of barium and titanium, preheated to a temperature of from 60°C to 65°C, and having a Ba/Ti the molar ratio of Ba/Ti of more than 1, and an aqueous basic solution (II) containing an inorganic or organic base, preheated to a temperature of from 60°C to 100°C; performing the reaction of

the solution (I) with the solution (II) at a temperature of from 60°C to 100 °C, while maintaining the reaction mixture at a constant OH<sup>-</sup> concentration, then filtrating and washing the resulting powdery reaction product with deionized water to remove impurity ions and the excessive barium ions, and finally, drying to obtain barium titanate powders.

According to the Examiner, Harada teaches a process for producing a dielectric material (paragraph [0035]) comprising spherical barium titanate particles, wherein the Ba/Ti ratio is greater than one (paragraph [0001]) wherein the particles are sintered into a ceramic body (paragraph [0055], lines 1-4) wherein the barium titanate is produced by mixing titanium tetrachloride (paragraph [0068], lines 3-5) with barium chloride or barium nitrate (paragraph [0071], lines 1-4) wherein the barium chloride or barium nitrate is introduced with an aqueous alkali solution (paragraph [0071, lines 4-6]) such as sodium hydroxide, potassium hydroxide or ammonia water (paragraph [0069], lines 1-3) and the aforementioned reactants mixed to produce a reaction solution is aged at a temperature of 40 to 100°C (paragraph [0076], lines 3-7] and then subjecting the reaction solution to hydrothermal treatment at a temperature of from 100 to 350°C (paragraph [0079], lines 1-4) wherein the particles obtained are filtered (paragraph [0112], lines 14-15) then washed with water and dried (paragraph [0080], lines 1-3).

The Examiner acknowledges that Harada fails to teach that the amount of OH<sup>-</sup> is constant. To overcome this deficiency of Harada, the Examiner relies on Woditsch. As previously argued, Applicants respectfully traverse, on the basis that Woditsch does not teach or suggest “maintaining the reaction mixture at a constant OH<sup>-</sup> concentration” in a one-step process for the preparation of barium titanate powders, as called for in claim 1.

Regarding Woditsch, the reference does not teach that OH<sup>-</sup> concentration remains constant over the course of the entire reaction, as required by claim 1. Importantly, and as explained in a prior response, when the reaction is performed in a multi-step process, the concentration of OH<sup>-</sup> steadily decreases during the course of the reaction. Applicants submit that Woditsch provides no suggestion for maintaining the OH<sup>-</sup> levels as a constant during the course of the entire reaction.

Importantly, and with reference to current claim 5, the present invention also claims the maintenance of a constant pH while the reaction occurs. The Examiner asserts that Woditsch teaches a process for making alkaline earth titanates by precipitating hydroxides at a constant pH value. Woditsch teaches only that by precipitating the hydroxides at a constant pH value, it is possible to obtain commercially processible, reactive hydroxides from zinc and alkaline earth metal hydroxides and  $\text{TiO}_2$ -hydrolyzate sludges, which are then calcined at high temperatures to form the corresponding alkaline earth metal titanates (*see* Woditsch at col. 2, lines 33-39). Thus, according to Woditsch, the purpose of maintaining a substantially constant pH value is to obtain readily filterable and washable precipitates, which can then be calcined at high temperatures to form titanates (*see* Woditsch at col. 2, lines 2-11). Thus, in view of Woditsch, the production of zinc or alkaline earth metal titanates still involves a two-step reaction: (1) precipitating zinc or alkaline earth metal hydroxides in the presence of finely divided titanium dioxide to obtain reactive hydroxides, and then (2) calcination (*see* Woditsch at col. 1, lines 49-54).

In sharp contrast to Harada and Woditsch, the reaction according to the present invention is carried out in accordance with the principle of one-step reaction and macroscopically, the aqueous solution of titanium and barium is reacted with an excess of  $\text{OH}^-$  in one step to obtain barium titanate powders as described in the present invention. The Examiner contends that independent claim 1 recites three steps: the reaction itself, filtering, and drying, and asserts that Woditsch teaches the reaction and calcinations, and that calcinations is analogous to the drying step in the current invention (*see* Office Action at p. 3). Applicants respectfully submit that this assertion is incorrect, and that one of ordinary skill in the art at the time of the present invention would understand that Woditsch teaches a two-step reaction, while the claimed process calls for a one-step reaction. The two other steps mentioned by the Examiner (filtering and drying) are after-treatment (or “after-reaction”) steps. In Woditsch, on the other hand, the first reaction step results in a suspension (which is subsequently filtered) and in the second reaction step the resultant filter cake is calcined at above  $500^\circ\text{C}$  to produce the desired titanate of a suitable particle size and narrow particle size distribution. It is well known in the art that the drying step is clearly different from the calcination step, with the latter being carried out at a much higher temperature – certainly, one of ordinary skill

in the art at the relevant time would understand this. In fact, the Woditsch reference itself acknowledges that the zinc titanates or earth metal titanates are not produced in the process taught therein until after the second step, i.e., calcination (*see, e.g.*, Woditsch at claim 1 (“calcining the solids at a temperature above about 500°C thereby to produce the titanate”); col. 1, lines 27-30 (“[u]sing titanium dioxide and the corresponding oxides or decomposable salts of magnesium or calcium as the starting materials, the alkaline earth metal titanate is obtained by calcination at high temperatures”); and col. 2, lines 37-39 (“reactive hydroxides from zinc and alkaline earth metal hydroxides and TiO<sub>2</sub>-hydrolyzate sludges which can be calcined at considerably lower temperatures, preferably below 900°C., to form the corresponding alkaline earth metal titanates ....”). Thus, Woditsch teaches a two-step reaction for producing titanates, which is unlike the claimed process which produces titanates in a one-step reaction. And, contrary to the claimed process, Woditsch does not teach or suggest “maintaining the reaction mixture at a constant OH concentration” over the entire course of the reaction that produces titanates, which would necessarily include the calcination step, because titanates are not produced until that step. In fact, Woditsch only teaches maintenance of constant pH during the first step of the reaction, i.e., precipitating hydroxides, and is absent any teaching or suggestion whatsoever of the pH during the second step of the reaction, i.e., calcination.

The Examiner suggests that Woditsch is only relied on to teach maintaining a constant pH during the reaction between Ba/Ti salts and the base. However, according to Harada, one of the starting materials (the titanium salt) is used in a form of hydroxide colloid produced by neutralizing an aqueous titanium salt solution with an aqueous alkali solution (paragraphs [0067] and [0068] of Harada), and the other (the barium salt) is used in the form of a basic solution by neutralizing with the aqueous alkali solution (paragraph [0071] of Harada). For completing the reaction, it is necessary to then age the resultant mixed solution after adding the aqueous barium solution to the titanium hydroxide colloid in the presence of a carboxylic acid, and to then hydrothermally treat the reaction solution. Therefore, if Woditsch is only relied upon to teach maintaining the pH constant during the reaction between Ba/Ti salts and the base, as suggested by the Examiner, some additional teaching or suggestion is needed for maintaining a constant pH during the additional reaction

steps of aging and hydrothermal treatment in Harada. In this aspect, Woditsch fails to cure the deficiencies of Harada.

The Examiner disagrees with this argument, suggesting that the present invention is in fact also directed to at least a two or three step reaction: (1) precipitating zinc or alkaline earth metal hydroxide, (2) filtering and washing, and (3) drying to obtain barium titanate powders. Applicants respectfully disagree.

In sharp contrast to Woditsch, the present invention does not involve precipitating zinc or alkaline earth metal hydroxide at all. As clearly described in Paragraph [0035] of the publication for the present application<sup>1</sup>, after the completion of the reaction, the precipitates of crystalline barium titanate are separated from the mother liquor by filtrating. This demonstrates that the aqueous solution (I) containing salts of barium and titanium and the aqueous solution (II) containing an inorganic or organic base are reacted to directly obtain crystalline barium titanate, instead of by means of hydroxide precipitates as suggested by the Examiner. Moreover, this further demonstrates that the reaction according to the present invention is carried out in one step.

With respect to the steps of filtering, washing, and drying, Applicants submit that these are each conventional after-treatment steps, as previously argued and supported by Harada. Specifically, paragraph [0080] of Harada teaches that the particles obtained by the hydrothermal treatment are thereafter washed with water and dried by conventional methods.

Applicants note that pending claim 1 first recites the step of performing the reaction of the solution (I) with the solution (II) while maintaining the reaction mixture at a constant OH-concentration, then filtrating and washing the resulting powdery reaction product and finally, drying to obtain barium titanate powders. This recitation clearly demonstrates that barium titanate powders are obtained immediately after the step of reacting the solution (I) and the solution (II), with filtrating, washing and drying being conventional after-treatment steps, during which no further reaction occurs. Thus, Applicants disagree with the Examiner's arguments suggesting that, according to Applicants' claimed invention, barium titanate is only formed (reacted) "after the

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<sup>1</sup> U.S. Patent Publication No. 2005/0019248

drying step.” Applicants submit rather that, according to the claimed invention, barium titanate is formed over the course of the one-step reaction, during which the reaction mixture is maintained at a constant OH<sup>-</sup> concentration and a constant pH. Applicants submit that Guo fails to make up for the deficiencies in Woditsch and Harada in disclosing the present invention

Applicants submit therefore that one of ordinary skill in the art at the time of the present invention could not therefore have employed the combined teachings of Guo and Woditsch in combination with Harada to reach the invention recited in claim 1 of the instant patent application. For the sake of completeness, the Applicants respectfully point out that claim 1 is not obvious even if one includes the teachings of Vita and Uedaira with those of Guo and Woditsch, because neither Vita nor Uedaira teach “maintaining the reaction mixture at a constant OH concentration”, and thus neither of these references can cure the deficiencies of Harada, Woditsch and Guo.

Claims 2-7 and 9 depend from claim 1. A dependent claim includes all the limitations of the claim from which it depends (and further limits the claim). Thus, because claim 1 is not rendered obvious over the cited references, claims 2-7 and 9 are not rendered obvious over the combined teachings of the cited references, either.

Dependent claim 10 is a product-by-process claim incorporating the process limitations of independent claim 1. Dependent claim 10 claims:

**10.** A barium titrate powder produced by the process of claim 1, consisting essentially of primary crystalline particles having a uniform particle size and an approximately spherical morphology.

Buchanan discloses a dielectric composition including zirconium dioxide in an amount of 0.5 to 2.0 percent weight. Similarly, as Harada disclosed a process by which barium titanate particles are pulverized and de-aggregated over an extended period in a ball mill containing zirconia beads, the composition disclosed by Harada arguably include a zirconia content as well (see, e.g., paragraph [0128] of Harada).. Because Applicants claimed powder is produced according to the process of claim 1, Applicants submit that zirconia is not a component of the claimed powder. For at least this reason, Applicants submit that claim 10 is not anticipated by either of Buchanan and

Harada and stands in condition for allowance. Because claims 11 and 12 depend from allowable claim 10, Applicants further submit that dependent claims 11 and 12 are also allowable for at least this reason.

Therefore, Applicants respectfully request that the rejections of claims 1 – 7 and 9 – 12 under 35 U.S.C. §§ 102(b), 103(a) be withdrawn.

### **CONCLUSION**

In view of the above amendments and remarks, it is respectfully requested that the application be reconsidered, and that the pending claims be allowed and the case passed to issue.

If there are any other issues remaining that the Examiner believes can be resolved through either a Supplemental Response or an Examiner's Amendment, the Examiner is respectfully requested to contact the undersigned at the telephone number indicated below.

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Respectfully submitted,

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